Postprint of a Scoping Review on Frailty in Patients with Knee Osteoarthritis

Authors: Tian Ziwei, Yang Zhilan, Zhao Huimin, Zhai Yanping, Li Hongyan, Du Miao, Jin Yuanyuan, Song Zeyu, Yang Zhilan

Date: 2025-04-07T00:00:00+00:00

Abstract

Background Knee osteoarthritis (KOA) is the fourth leading cause of disability worldwide, with its incidence and disability rates increasing annually. Frailty and KOA are interrelated, severely compromising the quality of life of patients with KOA.

Objective To conduct a scoping review of the prevalence, assessment tools, influencing factors, and intervention measures for frailty in KOA patients, thereby providing theoretical support for effective early prediction of frailty progression and personalized interventions.

Methods A scoping review methodology was employed, utilizing a combination of subject headings and free-text terms to search Web of Science, PubMed, Embase, Cochrane Library, CNKI, Wanfang Data Knowledge Service Platform, VIP, and Chinese Biomedical Literature Database for relevant studies on the prevalence, assessment tools, influencing factors, and intervention methods of frailty in KOA patients from database inception to December 12, 2024. Two researchers independently extracted, categorized, and analyzed the literature data.

Results Thirteen articles were ultimately included. The findings revealed that the prevalence of frailty among KOA patients ranged from 8.2% to 67.8%, with considerable variation in both incidence and severity across studies. While numerous assessment tools exist, there is a general lack of disease-specific instruments; the most frequently employed tools in the included studies were the Study of Osteoporotic Fractures (SOF) index, FRAIL scale, and Fried phenotype. Influencing factors primarily encompassed sociodemographic characteristics, disease-related parameters, and psychological/behavioral aspects. Intervention strategies comprised exercise training, traditional Chinese medicine combined with exercise therapy, and injection treatments.

Conclusion The prevalence of frailty in KOA patients demonstrates substantial heterogeneity. Regarding assessment tools, there is currently a paucity of specific instruments; future research should develop frailty prediction and assessment tools tailored to KOA patients in China to identify optimal time points for targeted interventions. Concurrently, efforts should concentrate on risk factors influencing frailty in KOA patients to delay frailty progression and enhance their quality of life.

Full Text

A Scoping Review of Frailty in Knee Osteoarthritis Patients

TIAN Ziwei[1], YANG Zhilan[1]*, ZHAO Huimin[1], ZHAI Yanping[2], LI Hongyan[1], DU Miao[1], JIN Yuanyuan[1], SONG Zeyu[1]

[1]School of Nursing, Shanxi University of Chinese Medicine, Jinzhong 030619, China
[2]Department of Internal Medicine, Shanxi Bethune Hospital, Taiyuan 030000, China

Corresponding author: YANG Zhilan, Professor; E-mail: 3173627973@qq.com

Abstract

Background: Knee osteoarthritis (KOA) is the fourth most disabling disease globally, with increasing incidence and disability rates each year. Frailty is associated with KOA and significantly reduces the quality of life of KOA patients.

Objective: To conduct a scoping review of the current status of frailty in KOA patients, assessment tools, influencing factors, and intervention measures, to provide theoretical support for early prediction of frailty progression and personalized intervention measures.

Methods: Using the scoping review method, a combination of subject headings and free terms was used to search Web of Science, PubMed, Embase, Cochrane Library, CNKI, Wanfang Data Knowledge Service Platform, VIP, and China Biomedical Database for relevant studies on the prevalence, assessment tools, influencing factors, and intervention methods for frailty in KOA patients. The search period was from database inception to December 12, 2024. Two researchers independently summarized, categorized, and analyzed the literature data.

Results: A total of 13 articles were finally included. The results showed that the incidence of frailty in KOA patients ranged from 8.2% to 67.8%, with some differences in incidence and severity across studies. Multiple assessment tools exist, but there is a general lack of disease-specific tools. The commonly used tools in studies were the Study of Osteoporotic Fractures (SOF) index, FRAIL scale, and Fried phenotype. Influencing factors mainly include sociodemographic factors, disease-related factors, and psychological/behavioral factors. Intervention

measures include exercise training, combined traditional Chinese medicine and exercise therapy, and injection therapy.

Conclusion: The incidence of frailty in KOA patients varies across studies. There is currently a lack of specific assessment tools. In the future, more suitable frailty prediction and assessment tools for KOA patients in China should be developed to provide critical time points for precise intervention. At the same time, efforts should focus on risk factors affecting frailty in KOA patients to delay frailty progression and improve their quality of life.

Keywords: Knee osteoarthritis; Frailty; Assessment tools; Influencing factors; Intervention measures; Scoping review

---

1. Methods

1.1 Research Question

According to the PCC (participant, concept, and context) principle established by Peters et al. [7], the research subjects were patients diagnosed with KOA; the concept of "frailty" is defined as a syndrome associated with aging, characterized by declining physiological reserves, multi-system functional decline, reduced ability to maintain homeostasis, and increased susceptibility to adverse outcomes, including physical, psychological, and social frailty [4]; the context refers to any environment where patients are located, such as medical or healthcare institutions, nursing homes, communities, or families. After discussion, the research team finally determined the following questions: (1) What is the current status of frailty in KOA patients both domestically and internationally? (2) What assessment tools are used to measure frailty in KOA patients? (3) What are the influencing factors that lead to frailty in KOA patients? (4) What intervention measures are currently available for frailty status in KOA patients both domestically and internationally?

1.2 Literature Search

A combination of subject headings and free terms was used to conduct computerized searches of four English databases (Web of Science, PubMed, Embase, Cochrane Library) and four Chinese databases (CNKI, Wanfang Data Knowledge Service Platform, VIP, and China Biomedical Literature Database). The search period ranged from database inception to December 12, 2024. Using PubMed as an example for English databases, the search expression was: (knee osteoarthritis[MeSH Terms]) OR ((((((((((knee osteoarthritis[Title/Abstract]) OR (osteoarthritis, knee[Title/Abstract])) OR (osteoarthritis[Title/Abstract])) OR (KOA[Title/Abstract])) OR (OA[Title/Abstract])) OR (proliferative[Title/Abstract])) OR (degenerative osteoarthritis[Title/Abstract])) OR (knee osteoarthritides[Title/Abstract]))

OR (osteoarthritis of knee[Title/Abstract])) OR (knee joint proliferative arthritis[Title/Abstract]))) AND (((((Frailty[Title/Abstract]) OR (Frailty Syndrome[Title/Abstract])) OR (Debilit*[Title/Abstract])) OR (Frail*[Title/Abstract])) OR (Frail[Title/Abstract])). Using CNKI as an example for Chinese databases, the search expression was: (SU %= osteoarthritis + osteoarthropathy + knee arthritis + knee osteoarthritis + degenerative osteoarthritis + knee osteoarthritis + knee joint proliferative arthritis + knee joint osteoarthritis) AND (SU %= frailty + weakness + pre-frailty + vulnerability + frailty syndrome + elderly frailty + elderly frailty syndrome).

1.3 Inclusion and Exclusion Criteria

Inclusion criteria: (1) Study subjects met the diagnostic criteria for osteoarthritis from the Orthopedic Branch of the Chinese Medical Association [8] or the revised KOA diagnostic criteria from the American College of Rheumatology [9]; (2) Study types included original studies such as cross-sectional studies, cohort studies, case-control studies, and intervention studies; (3) Study content involved research related to frailty in KOA patients. Exclusion criteria: (1) Literature for which full text could not be obtained; (2) Duplicate publications; (3) Non-Chinese or non-English literature.

1.4 Literature Screening and Data Extraction

A research team was established and all members received standardized training. For screening, literature was imported into NoteExpress 3.5 software for organization and deduplication, then screened in three steps. First, two members randomly selected five articles, independently read the titles and abstracts for practice, evaluated the explanatory power of the included literature for the research questions, and finally reached consensus. Subsequently, two members independently read the titles and abstracts of each article according to the inclusion and exclusion criteria to complete the initial screening. Finally, they carefully read the full text, evaluated the literature according to the exclusion criteria, completed the secondary screening, and cross-checked the retained literature. Microsoft Excel 2013 was used to catalog and sort the data. The information that finally reached consensus was extracted, summarized, and entered into an Excel spreadsheet. The extracted basic characteristics included: first author, country, publication year, study type, sample size, KOA patient frailty incidence rate, etc.

---

2. Results

2.1 Literature Search Results

This study retrieved a total of 5,368 articles. After screening and exclusion, 13 articles were finally included. The literature screening process is shown in

Figure 1 [Figure 1: see original paper].

2.2 Basic Characteristics of Included Literature

The 13 included articles [10-22] comprised 8 English articles [10-16, 20] and 5 Chinese articles [17-19, 21-22]. The countries of publication mainly included China, the United States, Thailand, South Korea, and Italy. The publication years ranged from 2017 to 2024. The sample sizes of the included studies ranged from 70 to 17,708 cases. The basic information of the included literature is shown in Table 1 .

2.3 Prevalence of Frailty in KOA Patients

Among the 13 included articles, 8 articles [12-16, 18-19, 21] reported the incidence of frailty in KOA patients (8.2%~67.8%). Two articles [10, 12] compared KOA patients with healthy control groups, finding that frailty was generally more prevalent and severe in the KOA group than in healthy controls, as shown in Table 1.

2.4 Assessment Tools for Frailty in KOA Patients

A total of 6 different assessment tools were used in the included studies, with specific information shown in Table 2 . In terms of measurement purpose, they can be divided into two types: single-dimension frailty assessment tools based on physical function, and multi-dimension frailty assessment tools involving psychological, physiological, and social aspects. In terms of tool properties, only the Study of Osteoporotic Fractures (SOF) index is disease-related, but it is not completely specific, while the remaining scales are generic scales that can be used for frailty assessment in other diseases. Among the included articles, the most frequently used tool was the Study of Osteoporotic Fractures (SOF) index (n=3), followed by the FRAIL scale (n=2) and the FRIED phenotype (n=2).

2.5 Influencing Factors for Frailty in KOA Patients

(1) Sociodemographic factors: KOA patients with the following special demographic characteristics are more likely to develop frailty, mainly including advanced age [10, 13], abnormal BMI [10, 18], low-income status [10, 18], education level [17], visual and hearing impairment [17], and unmarried or living alone status [17]. (2) Disease-related factors: KOA patients with the following special disease factors are more likely to develop frailty, mainly including K-L grade III-IV [10], biological indicators (higher white blood cell count, higher platelet count, higher serum creatinine level, and high hemoglobin) [10], polypharmacy [12, 15], pain (long duration and severe degree) [11-12, 18-19], comorbidities [12], severe knee symptoms [13], and functional dependence [13]. (3) Psychological and behavioral factors: KOA patients with the following psychological and behavioral factors are

more likely to develop frailty, mainly including lower social support [17], smoking status [10], alcohol consumption [10], diet and nutrition (malnutrition, low magnesium intake, and higher dietary inflammatory index score) [13-14, 16], and exercise (regular walking habits) [10, 17].

2.6 Intervention Measures for Frailty in KOA Patients

Among the 13 included articles, 3 articles [20-22] explored frailty as one of the outcome indicators for intervention in KOA patients. Intervention methods identified included three main categories: exercise training, combined traditional Chinese medicine and exercise therapy, and injection therapy. (1) Exercise training: In an 8-week single-blind randomized controlled trial conducted in the United States, PARK et al. [20] compared chair yoga training with a health education program in 112 elderly patients with lower extremity osteoarthritis, and the results showed that chair yoga training could not reduce frailty levels. (2) Combined traditional Chinese medicine and exercise therapy: XU Jin [21] conducted a 6-week randomized controlled trial of heat-sensitive moxibustion combined with exercise in 70 KOA patients with frailty and found that the heat-sensitive moxibustion combined with exercise program could improve the frailty status of KOA patients with frailty, and had positive significance in relieving pain, improving joint function, and restoring motor ability. (3) Injection therapy: In a randomized controlled trial of 109 KOA patients, QI Xiang et al. [22] confirmed that platelet-rich plasma (PRP) therapy could reduce frailty levels in elderly KOA patients, while vitamin D deficiency would accelerate the frailty process in elderly KOA patients.

---

3. Discussion

3.1 Focus on High-Risk Groups and Develop Specific Prediction Tools

Currently, the incidence of frailty in KOA patients varies significantly across different studies (8.2%~67.8%), which may be due to inconsistent frailty assessment tools used in different studies. This study found that most existing studies on KOA patients use generic scales to assess frailty, which cannot reflect the specificity of KOA patients. Therefore, future research needs to further incorporate KOA-related factors to improve disease specificity in frailty assessment. In addition, early frailty is reversible [4], so early identification and intervention are particularly important. In the future, we can predict frailty based on "modifiable influencing factors" such as pain level, BMI, smoking status, alcohol consumption, and regular walking habits, while applying machine learning and big data research to construct frailty prediction models for KOA patients, formulate corresponding personalized intervention strategies, enable timely assessment, identification, and preventive management, and help community workers and orthopedic medical staff accurately grasp the entry points for guidance and intervention to delay frailty progression.

3.2 Further Identify and Focus on Influencing Factors

The current research results on influencing factors for frailty in KOA patients are relatively consistent, with pain, white blood cell count, and polypharmacy having been confirmed by multiple studies. Studies by Wade et al. [23] and Weaver et al. [24] showed that more severe pain is associated with more severe frailty. The reason is that persistent pain leads to decreased physical function, reduced motor ability, decreased nutritional intake, and onset of comorbidities such as depression, thereby causing and accelerating frailty in the elderly. Kanapur et al. [25] showed that increased white blood cells are associated with normal aging, sarcopenia, and late-life diseases (such as cardiovascular disease). Fried et al. [26] showed that polypharmacy increases drug interactions [27] and overall adverse events [28], increasing frailty in the elderly. However, this review also identified gaps in the exploration of influencing factors for frailty in KOA patients, and some indicators commonly associated with both frailty and KOA have not been included: in terms of inflammatory indicators, joint degeneration in KOA patients is accompanied by chronic low-grade inflammation, with elevated levels of pro-inflammatory factors (such as interleukin-6, tumor necrosis factor-α) [29]. These inflammatory factors not only accelerate cartilage degradation but can also lead to frailty through systemic inflammatory responses and neuroendocrine disorders [30]; in terms of mental health, chronic pain and functional disability in KOA patients can lead to depression, anxiety, and social isolation [31], and these psychological problems exacerbate frailty through behavioral changes and neurobiological mechanisms [32], but similar relevant indicators have not been studied in KOA patients. The association between KOA and frailty is not driven by a single factor but is the result of multi-dimensional interactions [33]. Therefore, in analyzing influencing factors for frailty in KOA patients, it is recommended to conduct research from its underlying mechanisms, carry out and focus on multi-dimensional studies to provide reference for later intervention research.

3.3 Further Optimize and Deepen Intervention Research

Current intervention measures have notable limitations in delaying frailty in KOA patients. Through literature retrieval, it was found that most intervention studies [34-36] have outcome indicators of improving pain and physical function in KOA patients. Although studies have shown that these outcome indicators are the main pathways leading to frailty, they are all indirect. Only a few studies have included frailty as one of the outcome indicators, and among these few studies, there are still small sample sizes, short intervention durations, and failure to fully consider individual differences in KOA patients. Future research should include frailty as an outcome indicator more often, expand sample diversity and representativeness, and since frailty requires long-term tracking, prospective clinical studies with long cycles, multiple centers, and large samples should be conducted. In addition, multidisciplinary collaboration should be carried out to integrate professional knowledge from different fields to jointly

explore scientific and effective frailty management programs for KOA patients.

This scoping review summarizes the prevalence, assessment tools, influencing factors, and intervention measures of frailty in KOA patients, aiming to provide reference for in-depth follow-up research. However, since this study did not conduct literature quality assessment, it may have some potential impact on the conclusions. Currently, the incidence of frailty in KOA patients varies across studies; there is a lack of specific assessment tools, and more suitable frailty prediction and assessment tools for KOA patients in China should be developed in the future to provide critical time points for precise intervention. At the same time, efforts should focus on risk factors affecting frailty in KOA patients, implement interventions through long-term observation of trajectories and multidisciplinary approaches, delay frailty progression in KOA patients, improve their quality of life, and promote healthy aging.

References

[1] Chinese Association of Physical Medicine and Rehabilitation, West China Hospital of Sichuan University. Chinese guidelines for rehabilitation treatment of knee osteoarthritis (2023 edition) [J]. Chinese Journal of Evidence-Based Medicine, 2024, 24(1): 1-14.

[2] COLLABORATORS G O M D. Global, regional, and national burden of other musculoskeletal disorders, 1990-2020, and projections to 2050: a systematic analysis of the Global Burden of Disease Study 2021 [J]. Lancet Rheumatol, 2023, 5(11): e670-e682. DOI: 10.1016/S2665-9913(23)00232-1.

[3] VERONESE N, MAGGI S, TREVISAN C, et al. Pain increases the risk of developing frailty in older adults with osteoarthritis [J]. Pain Med, 2017, 18(3): 414-427. DOI: 10.1093/pm/pnw163.

[4] Chinese Geriatrics Society, Editorial Board of Chinese Journal of Geriatrics, YANG Yunmei, et al. Chinese expert consensus on frailty prevention in the elderly (2022) [J]. Chinese Journal of Geriatrics, 2022, 41(5): 503-511. DOI: 10.3760/cma.j.issn.0254-9026.2022.05.001.

[5] LOESER R F. Aging and osteoarthritis [J]. Curr Opin Rheumatol, 2011, 23(5): 492-496. DOI: 10.1097/bor.0b013e3283494005.

[6] SHI Zhenyu, LI Renliang, HU Ziyi. Exploring the causal association between frailty and knee osteoarthritis based on Mendelian randomization [J]. Modern Medical Journal, 2023, 51(10): 2146-2153. DOI: 10.1093/pm/pnx296.

[7] PETERS M D J, MARNIE C, TRICCO A C, et al. Updated methodological guidance for the conduct of scoping reviews [J]. JBI Evid Synth, 2020, 18(10): 2119-2126. DOI: 10.11124/JBIES-20-00167.

[8] Joint Surgery Group of Orthopedic Branch of Chinese Medical Association, Osteoarthritis Group of Chinese Association of Orthopedic Surgeons, National Clinical Research Center for Geriatric Disorders (Xiangya Hospital), et al. Chinese guidelines for the diagnosis and treatment of osteoarthritis (2021 edition) [J]. Chinese Journal of Orthopedics, 2021, 41(18): 1291-1314. DOI: 10.3760/cma.j.cn121113-20210624-00424.

[9] KOLASINSKI S L, NEOGI T, HOCHBERG M C, et al. 2019 American college of rheumatology/arthritis foundation guideline for the management of osteoarthritis of the hand, hip, and knee [J]. Arthritis Rheumatol, 2020, 72(2): 220-233. DOI: 10.1002/art.41142.

[10] JOO S H, SONG J W, SHIN K, et al. Knee osteoarthritis with a high grade of Kellgren-Lawrence score is associated with a worse frailty status, KNHANES 2010-2013 [J]. Sci Rep, 2023, 13(1): 19714. DOI: 10.1038/s41598-023-46558-2.

[11] BINDAWAS S M, VENNU V, STUBBS B. Longitudinal relationship between knee pain status and incident frailty: data from the osteoarthritis initiative [J]. Pain Med, 2018, 19(11): 2146-2153. DOI: 10.1093/pm/pnx296.

[12] SALAFFI F, DI CARLO M, CAROTTI M, et al. Frailty prevalence according to the Survey of Health, Ageing and Retirement in Europe-Frailty Instrument (SHARE-FI) definition, and its variables associated, in patients with symptomatic knee osteoarthritis: findings from a cross-sectional study [J]. Aging Clin Exp Res, 2021, 33(6): 1519-1527. DOI: 10.1007/s40520-020-01667-0.

[13] WANARATNA K, MUANGPAISAN W, KUPTNIRATSAIKUL V, et al. Prevalence and factors associated with frailty and cognitive frailty among community-dwelling elderly with knee osteoarthritis [J]. J Community Health, 2019, 44(3): 587-595. DOI: 10.1007/s10900-018-00614-5.

[14] VERONESE N, STUBBS B, MAGGI S, et al. Dietary magnesium and incident frailty in older people at risk for knee osteoarthritis: an eight-year longitudinal study [J]. Nutrients, 2017, 9(11): 1253. DOI: 10.3390/nu9111253.

[15] VERONESE N, STUBBS B, NOALE M, et al. Polypharmacy is associated with higher frailty risk in older people: an 8-year longitudinal cohort study [J]. J Am Med Dir Assoc, 2017, 18(7): 624-628. DOI: 10.1016/j.jamda.2017.02.009.

[16] SHIVAPPA N, STUBBS B, HÉBERT J R, et al. The relationship between the dietary inflammatory index and incident frailty: a longitudinal cohort study [J]. J Am Med Dir Assoc, 2018, 19(1): 77-82. DOI: 10.1016/j.jamda.2017.08.006.

[17] BAI Huiqiong, WEI Pingping, GUO Jinrong, et al. Current status and influencing factors of social frailty in elderly patients with knee osteoarthritis in community [J]. Evidence-Based Nursing, 2023, 9(6): 1095-1100. DOI: 10.12102/j.issn.2095-8668.2023.06.029.

[18] FANG Wen, WANG Xiuhong, WANG Junhua, et al. Analysis of frailty status and its influencing factors in elderly patients with knee osteoarthritis

awaiting surgery [J]. Chinese General Practice, 2020, 23(30): 3839-3845. DOI: 10.12114/j.issn.1007-9572.2020.00.126.

[19] ZHANG Liyi, ZHANG Quan, LIU Qiang, et al. Relationship between symptomatic knee osteoarthritis and frailty in Chinese elderly population [J]. Chinese Journal of Geriatrics, 2023, 42(9): 1117-1122. DOI: 10.3760/cma.j.issn.0254-9026.2023.09.017.

[20] PARK J, SHERMAN D G, AGOGO G, et al. Frailty modifies the intervention effect of chair Yoga on pain among older adults with lower extremity osteoarthritis: Secondary analysis of a nonpharmacological intervention trial [J]. Exp Gerontol, 2020, 134: 110886. DOI: 10.1016/j.exger.2020.110886.

[21] XU Jin. Application study of heat-sensitive moxibustion combined with exercise on patients with knee osteoarthritis and frailty [D]. Nanchang: Nanchang University, 2022. DOI: 10.27232/d.cnki.gnchu.2022.000542.

[22] QI Xiang, ZHANG Jialei, NIU Aiqing, et al. Correlation analysis between vitamin D level and platelet-rich plasma in the treatment of knee osteoarthritis in elderly patients [J]. Chinese Journal of Painology, 2024, 20(3): 374-378. DOI: 10.3760/cma.j.cn101658-20230802-00010.

[23] WADE K F, LEE D M, MCBETH J, et al. Chronic widespread pain is associated with worsening frailty in European men [J]. Age Ageing, 2016, 45(2): 268-274. DOI: 10.1093/ageing/afv170.

[24] WEAVER G D, KUO Y F, RAJI M A, et al. Pain and disability in older Mexican-American adults [J]. J Am Geriatr Soc, 2009, 57(6): 992-999. DOI: 10.1111/j.1532-5415.2009.02263.x.

[25] KANAPURU B, ERSHLER W B. Inflammation, coagulation, and the pathway to frailty [J]. Am J Med, 2009, 122(7): 605-613. DOI: 10.1016/j.amjmed.2009.01.030.

[26] FRIED L P, TANGEN C M, WALSTON J, et al. Frailty in older adults: evidence for a phenotype [J]. J Gerontol A Biol Sci Med Sci, 2001, 56(3): M146-M156. DOI: 10.1093/gerona/56.3.m146.

[27] FIALOVÁ D, ONDER G. Medication errors in elderly people: contributing factors and future perspectives [J]. Br J Clin Pharmacol, 2009, 67(6): 641-645. DOI: 10.1111/j.1365-2125.2009.03419.x.

[28] WALLACE E, STUART E, VAUGHAN N, et al. Risk prediction models to predict emergency hospital admission in community-dwelling adults: a systematic review [J]. Med Care, 2014, 52(8): 751-765. DOI: 10.1097/MLR.0000000000000171.

[29] SCHAAP L A, PLUIJM S M F, DEEG D J H, et al. Inflammatory markers and loss of muscle mass (sarcopenia) and strength [J]. Am J Med, 2006, 119(6): 526.e9-526.17. DOI: 10.1016/j.amjmed.2005.10.049.

[30] SOYSAL P, STUBBS B, LUCATO P, et al. Inflammation and frailty in the elderly: a systematic review and meta-analysis [J]. Ageing Res Rev, 2016, 31: 1-8. DOI: 10.1016/j.arr.2016.08.006.

[31] STUBBS B, VANCAMPFORT D, VERONESE N, et al. Depression and pain: primary data and meta-analysis among 237 people across 47 low- and middle-income countries [J]. Psychol Med, 2017, 47(16): 2906-2917. DOI: 10.1017/S0033291717001477.

[32] VAUGHAN L, CORBIN A L, GOVEAS J S. Depression and frailty in later life: a systematic review [J]. Clin Interv Aging, 2015, 10: 1947-1958. DOI: 10.2147/CIA.S69632.

[33] CALVANI R, MARINI F, CESARI M, et al. Biomarkers for physical frailty and sarcopenia: state of the science and future developments [J]. J Cachexia Sarcopenia Muscle, 2015, 6(4): 278-286. DOI: 10.1002/jcsm.12051.

[34] ZHOU Xuelai, DENG Dun, SHEN Bin, et al. Analysis of application effect of press-needle combined with ear acupoint pressing in knee osteoarthritis patients with qi and blood deficiency syndrome [J]. Chinese Journal of General Practice, 2022, 20(1): 121-124. DOI: 10.16766/j.cnki.issn.1674-4152.2022.01.032.

[35] GOHIR S A, EEK F, KELLY A, et al. Effectiveness of Internet-based exercises aimed at treating knee osteoarthritis: the iBEAT-OA randomized clinical trial [J]. JAMA Netw Open, 2021, 4(2): e210012. DOI: 10.1001/jamanetworkopen.2021.0012.

[36] XIAO C M, LI J J, KANG Y, et al. Follow-up of a Wuqinxi exercise at home programme to reduce pain and improve function for knee osteoarthritis in older people: a randomised controlled trial [J]. Age Ageing, 2021, 50(2): 570-575. DOI: 10.1093/ageing/afaa179.

Author Contributions

TIAN Ziwei was responsible for conceptualization and design of the article and drafting and revision of the manuscript; YANG Zhilan was responsible for implementation and feasibility analysis of the research, and had overall responsibility for supervision and management of the article; ZHAO Huimin and ZHAI Yanping were responsible for quality control and review of the article; LI Hongyan and DU Miao were responsible for literature screening and organization; JIN Yuanyuan and SONG Zeyu were responsible for data extraction and organization; all authors confirmed the final version of the manuscript.

Conflict of Interest

This article has no conflict of interest.

ORCID

TIAN Ziwei https://orcid.org/0009-0004-4475-5306
YANG Zhilan https://orcid.org/0009-0005-9202-330X

Note: Figure translations are in progress. See original paper for figures.